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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
CHAN, HENG M	

ART UNIT	PAPER NUMBER
4181	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/585,094	PENICAUD ET AL.	
	Examiner	Art Unit	
	HENG M. CHAN	4181	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10/16/2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) *13-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *06/30/2006*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Claims 1-15 are pending and the applicant's election of Group 1, claims 1-12, in the reply filed on 10/16/2008 is acknowledged. Claims 1-12 are presented for examination on the merits. Claims 13-15 are withdrawn from consideration. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Information Disclosure Statement

The information disclosure statement filed on 06/30/2006 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because the international search report is not a document where the list of reference is not included in PTO-1449. 37 CFR 1.98(a)(1) requires the following: (1) a list of all patents, publications, applications, or other information submitted for consideration by the Office; (2) U.S. patents and U.S. patent application publications listed in a section separately from citations of other documents; (3) the application number of the application in which the information disclosure statement is being submitted on each page of the list; (4) a column that provides a blank space next to each document to be considered, for the examiner's initials; and (5) a heading that clearly indicates that the list is an information disclosure statement. The information disclosure statement has been placed in the application file,

but the international search report and international preliminary report listed under NPL are improper references and therefore have not been considered.

Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609.05(a).

Specification

The abstract of the disclosure is objected to because it contains a legal term "said." Correction is required. See MPEP § 608.01(b).

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation "the reduction" in line 2. There is insufficient antecedent basis for this limitation in the claim.

Regarding claim 3, the phrase "such as" renders the claim indefinite because it is unclear whether the limitations following the phrase are part of the claimed invention. See MPEP § 2173.05(d).

Claim 5 recites the limitation "the polar organic solvents" in line 2. There is insufficient antecedent basis for this limitation in the claim.

Claim 6 recites the limitation "the nanotubes contain boron as a substitute for carbon" in lines 2-3. It is unclear about whether the boron is contained in the wall of the nanotube, inside the nanotube, in a functional group on the surface or end of the nanotube, etc. It is also unclear about the extent of substitution.

Claim 9 recites the limitation "empty nanotubes" in line 2. It is unclear what "empty" means, for example, does it mean hollow, bearing pores, etc.?

Regarding claim 10, the phrase "for example" renders the claim indefinite because it is unclear whether the limitation(s) following the phrase are part of the claimed invention. See MPEP § 2173.05(d). Additionally, the instant claim recites the limitation "contain molecules" in line 2. It is unclear what is the relationship between the molecules and the nanotubes, for example, are the molecules attached to or mixed with the nanotubes?

The other claims are indefinite because they depend on indefinite claims.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4 and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by a journal article published in Chemical Physics Letters 318 (2000) 561-564 by Jouguelet et al. entitled "Controlling the electronic properties of single-wall carbon nanotubes by chemical doping" (Applicant's admitted prior art).

Regarding claim 1, the instant claim is interpreted that by reduction of carbon nanotubes, dissolving carbon nanotubes and negatively charged nanotubes with positive counterions are achieved, regardless of the medium in which the nanotubes are dissolved. That is, by meeting the limitation of reduction of carbon nanotubes, the method of dissolving carbon nanotubes is satisfied. Jouguelet et al. teaches that single-walled carbon nanotube are subjected to redox reactions with solutions of organic radical-anions to form a chemical composition LiC_x, with C_x being the negatively charged carbon nanotube and Li^+ the counter ion (page 561, 2nd paragraph of introduction and page 562, 1st paragraph).

Regarding claim 2, Jouguelet et al. teaches that the counterion is Li^+, which is an alkali metal cation (page 562, 1st paragraph).

Regarding claims 3 and 4, Jouguelet et al. teaches that in a glass apparatus sealed under high vacuum (i.e. under anaerobic condition), a sample of carbon single-

wall nanotubes (SWNTs) was exposed to molecules that are radical-anions of naphthalene, benzophenone, fluorenone, anthraquinone and benzoquinone, with Li^+ as a counter ion (page 562, 1st paragraph). Thus, the molecules are salts of a cation of an alkali metal ion (i.e. lithium) and a polyaromatic compound (i.e. naphthalene, benzophenone, fluorenone, anthraquinone, or benzoquinone).

Regarding claim 7, Jouguelet et al. teaches using carbon single-wall nanotubes (page 561, introduction 1st paragraph).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 5 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jouguelet et al. as applied above, in view of a journal article published in the Journal of American Chemical Society (2003), 125, 9258-9259 entitled "Single-step *in situ* synthesis of polymer-grafted single-wall nanotube composites" by Ajayan et al. (hereinafter Ajayan I)

Regarding claim 12, Jouguelet et al. does not specifically teach that the nanotubes undergo a step of functionalizing the surface or the ends of the nanotubes.

Ajayan I teaches that SWNTs in cyclohexane are treated with *sec*-butyllithium and then styrene monomer. Ajayan I introduces carbanions on the SWNT surface (that is forming negatively charged nanotubes) by treatment with the anionic initiator that serves to exfoliate the bundles in solution and provide initiating sites for polymerization of styrene (Page 9258, left column, 3rd paragraph; Figure 1). The resulting intimately mixed composite system is a result of functionalizing the surface of the nanotubes.

It would have been obvious to one of ordinary skill in the art at time of invention to have added a step of functionalizing the surface or the ends of the nanotubes in Jouguelet et al.'s method, motivated by the teachings of Ajayan I that nanotubes carbanions (*i.e.* negatively charged nanotubes) in solution can be utilized to make useful composite material for applications such as filters.

Regarding claim 5, it is unclear about the role of a polar organic solvent chosen from sulfolane, dimethyl sulfoxide, dimethylformamide, N-methylpyrrolidone and N-methylformamide in the method of claim 1. That is, the specific polar organic solvent can be present at any stage of the reduction reaction, for example, after the reduction reaction. Jouguelet et al. teaches using tetrahydrofuran (THF) (page 563, left column, 1st paragraph).

Jouguelet et al. does not specifically teach using a polar organic solvent chosen from sulfolane, dimethyl sulfoxide, dimethylformamide, N-methylpyrrolidone and N-methylformamide.

Ajayan I teaches that the composites including the nanotubes are soluble in organic solvents such as dimethyl formamide, chloroform, and tetrahydrofuran (Page 9258, right column, 1st paragraph).

It would have been obvious to one of ordinary skill in the art at time of invention to have used a polar organic solvent in Jouguelet et al.'s method, motivated by the teaching of Ajayan I that the nanotube composites are soluble in polar organic solvents such as dimethylformamide.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jouguelet et al. in view of an International Application Publication WO 2004/046031 by Ajayan et al. (hereinafter Ajayan II).

Regarding claim 8, Jouguelet et al. does not specifically teach that the nanotubes used in the method are multi-walled nanotubes.

Ajayan II discloses an invention relating to single and multiwalled carbon nanotube/polymer composites (paragraph 02). Ajayan II employs an ionizing agent which can add to double bonds on the carbon nanotube (CNT) surface thereby generating anions (carbanions) on the surface of the underivatized CNTs. Ionizing agents include, for example, metal organic initiators such as alkyl lithium compounds (salts) and radical ionic initiators such as sodium naphthalenide (paragraph 20).

Therefore, it would have been obvious to one of ordinary skill in the art at time of invention to have used multi-walled nanotubes in the method provided by Jouguelet et

al., motivated by the fact that Ajayan II has demonstrated the formation of carbanions on the surface of the carbon nanotubes (*i.e.* negatively charged nanotubes), which can be single-walled or multi-walled.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jouguelet et al. as applied above, in view of a journal article published in the Journal of the American Chemical Society (2003) 125, 8, 2062-2063, entitled "Functionalized boron nitride nanotubes with a stannic oxide coating: a novel chemical route to full coverage" by Zettl et al. and Ajayan I.

Regarding claim 6, Jouguelet et al. does not specifically teach using nanotubes that contain boron as a substitute for carbon.

Zettl et al. discloses that have intrinsic electronic properties of boron nitride (BN) nanotubes might be advantageously exploited for various applications including sensors and functionalization of BN nanotubes with foreign chemical species attached to the BN nanotube, either directly or via an intermediate active coating layer, could electronically dope the nanotube and thus directly influence its electrical conductance (page 2062, 2nd paragraph). That is, Zettl et al. suggests functionalization of the BN nanotubes surface by introducing foreign chemical species directly or indirectly attached to the BN nanotubes.

Similarly, Ajayan I (see above) also teaches the functionalization of the surface of the nanotubes, carbon nanotubes in this case for useful applications such as filters. It

would have been obvious to one of ordinary skill in the art at time of invention to have used nanotubes that contain boron as a substitute for carbon (*e.g.* BN nanotubes) in place of carbon nanotubes in the method provided by Jouguelet et al., motivated by the similar teachings of Zettl et al. and Ajayan I (see above) that both teach functionalization of the surface of the nanotubes for useful applications and the fact that Jouguelet et al. provides a method to activate the surface of nanotubes to enable functionalization reactions such as polymerization taught by Ajayan I.

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Claims 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jouguelet et al. as applied above, in view of US Patent no. 5,695,734 to Ikazaki et al.

Regarding claim 10, the instant claim is interpreted that the nanotubes used contain any molecules including contaminant molecules in a mixture.

Regarding claims 10 and 11, Jouguelet et al. does not specifically teach that the nanotubes contain any molecules or that the method of dissolving carbon nanotubes further includes a step of purifying the nanotubes.

Ikazaki et al. discloses a process for the isolation of carbon nanotubes from a mixture containing carbon nanotubes and graphite particles (column 1, lines 5-7). Ikazaki et al. teaches that the mixture is first reacted with a metal compound to intercalate the metal compound (preferably a halide) between layers of the graphite (column 2, lines 19-21). The mixture containing the carbon nanotubes and graphite into

which the metal compound has been intercalated is eventually subjected to a reduction treatment with, for example, a reducing agent such as metallic lithium or metallic sodium in a liquid medium such as a tetrahydrofuran containing naphthalene (column 2, lines 39-50). The product obtained by the reduction treatment and containing the carbon nanotubes and the elemental metal-carrying graphite is then oxidized at a an elevated temperature to burn the graphite, leaving the carbon nanotubes behind (column 2, lines 51-61).

It would have been obvious for one of ordinary skill in the art at time of invention to have used nanotubes containing impurities such as graphite particles and added a step of purifying the nanotubes in the method provided by Jouguelet et al., motivated by the teachings of Ikazaki et al. that reduction of carbon nanotubes can be used as a step in the process of purifying the nanotubes (as cited in claim 11) from a mixture of carbon nanotubes and graphite particles (i.e. nanotubes that contain molecules as cited in claim 10).

Regarding claim 9, the instant claim is interpreted that the nanotubes are hollow. Jouguelet et al. does not specifically teach using hollow nanotubes.

Ikazaki et al. defines carbon nanotubes as hollow graphite tubules having a diameter of generally several to several tens nanometers (column1, lines 8-10).

It would have been obvious for one of ordinary skill in the art at time of invention to have used hollow nanotubes in the method provided by Jouguelet et al., motivated by

the demonstration of Ikazaki et al. that carbon nanotubes are known to be hollow graphite tubules, which are subjected to a reduction treatment.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to HENG M. CHAN whose telephone number is (571)270-5859. The examiner can normally be reached on Monday to Friday, 8:00 am EST to 5:30 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vickie Kim can be reached on (571)272-0579. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MICHAEL MARCHESCHI/

Primary Examiner, Art Unit 1793

HMC